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## NOAA's Marine Aquaculture Program Competitive Grants

The National Oceanic and Atmospheric Administration (NOAA) is currently seeking proposals for the 2006 Marine Aquaculture Program, which is an open competition for up to \$4 million in grants to be awarded in 2006. Coordinated by the NOAA Aquaculture Program and NOAA Research, the 2006 grants competition will focus on demonstration projects and innovative research for the development of environmentally and economically sustainable marine aquaculture in nearshore, open water, and terrestrial environments. In past years, this competition was known as the National Marine Aquaculture Initiative.

The deadline for preliminary proposals is February 28, 2006. The deadline for full proposals is April 13, 2006. Institutions of higher education, nonprofit organizations, commercial organizations, Federal, State, local and Indian tribal governments, and individuals are eligible to apply.

To learn more about this funding opportunity, including specific details on eligibility and the process for submitting proposals, click on the links below.

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## Executive Summary

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#### Executive Summary NOAA Marine Aquaculture Program

- **Federal Agency Name(s):** NOAA Aquaculture Program, Oceanic and Atmospheric Research (OAR), National Oceanic and Atmospheric Administration (NOAA), Department of Commerce
- **Funding Opportunity Title:** NOAA Marine Aquaculture Program
- **Announcement Type:** Initial Announcement
- **Funding Opportunity Number:** OAR-SG-2006-2000489
- **Statutory Authority:** 33 U.S.C. 1121-1131
- **Catalog of Federal Domestic Assistance (CFDA) Number(s):** 11.417
- **Dates:** Preliminary proposals must be received by NOAA by 4 p.m. EST on Tuesday, February 28, 2006. Full proposals must be received by NOAA by 4 p.m. EST on Thursday, April 13, 2006. Notice of encouragement for preliminary proposals to be developed into full proposals should be provided on or about March 10, 2006. Only those who submit preliminary proposals meeting the preliminary proposal deadline and other requirements of this notice are eligible to submit full proposals.

**Funding Opportunity Description:** NOAA is seeking proposals for demonstration projects and innovative research for the development of environmentally and economically sustainable marine aquaculture in nearshore, open water, and terrestrial environments. The Great Lakes are considered marine for this competition. Projects funded under this competition should support NOAA's overall goals for its marine aquaculture program, which are to:

1. Establish a comprehensive regulatory program for the conduct of marine aquaculture operations;
2. Develop appropriate technologies to support commercial marine aquaculture and enhancement of wild stocks;
3. Establish and implement procedures for the environmental assessment and monitoring of marine aquaculture activities;
4. Conduct education and outreach activities to establish a well informed public on marine aquaculture; and
5. Meet international obligations to promote environmentally sustainable practices for the conduct of marine aquaculture.

Accomplishment of these goals should lead to a well-managed marine aquaculture industry in the United States; a well-informed public that understands U.S. aquaculture issues, and improved access to the latest aquaculture research results.

NOAA will hold an open competition for up to \$4 million for FY2006, with individual projects up to \$800,000 for a two-year period. It is anticipated that we will make approximately ten awards, two or three pilot scale

demonstration projects at the \$800,000 level for the two-year period and the remainder at or about the \$200,000 level.

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### **I. Funding Opportunity Description**

#### **A. Program Objectives**

Worldwide fisheries production will be inadequate to meet the needs of the world's population without supplementation through aquaculture and marine fish enhancement. The development of a robust aquaculture industry can help meet the seafood needs of the domestic market, reduce imports of fishery products and benefit the nation's balance of trade. In the United States, marine aquaculture has been slow to develop for a variety of reasons including the lack of technologies, multi-use conflicts in the coastal zone, and difficult and expensive permit and licensing processes, to name a few. However, none of these problems are insurmountable. NOAA created the NOAA Aquaculture Program in 2004 to address these challenges and opportunities. The NOAA Aquaculture Program includes activities at the Office of Oceanic and Atmospheric Research (OAR), NOAA Fisheries (NMFS), National Ocean Service (NOS), and the National Environmental Satellite Data Information Service (NESDIS).

NOAA recognizes the role of other Departments such as United States Department of Agriculture and Department of Interior and state and regional management partners in aquaculture and coordinates with other Department representatives at the regional level and at the national level through the Joint Subcommittee on Aquaculture.

#### **B. Program Priorities**

NOAA encourages proposals that address the following: demonstration projects, research, and industry development priorities. Applicants should check with the list of projects funded during the last five years by the National Marine Aquaculture Initiative to determine what has already been funded and how a proposed project might contribute to the NOAA Aquaculture Program.

(To view projects by topic, [click here](#).)

Demonstration. Projects to allow pilot scale testing of technologies to prove concepts, evaluate and or establish economic feasibility, conduct environmental monitoring and modeling, develop multi-use platforms and evaluate marine stock enhancement and production technologies are high priority for this competition.

Research and Industry Development. Aquaculture research can include husbandry; system engineering; nutrition; environmental studies including

monitoring and GIS and environmental modeling for site selection; disease diagnostics and control; social sciences; economics and marketing; product transport and product development; worker safety; and other disciplines. NOAA is seeking proposals on enabling technologies for less developed areas of aquaculture such as offshore or open ocean, coastal/estuarine, water re-use systems and marine stock enhancement. We are also looking for proposals on the environmental, genetic and trophic level consequences of marine aquaculture and marine species enhancement.

### **C. Program Authority**

Authority for the Regional Research, Information Planning and Coordination is provided by 33 U.S.C. 1121-1131. Catalog of Federal Domestic Assistance (CFDA) Number(s): 11.417

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## **II. Award Information**

### **A. Funding Availability**

Up to \$4 million will be available for proposals of one or two year's duration, with individual projects up to \$400,000 per year for a maximum of \$800,000 for the two-year period.

Approximately ten awards will be made, two or three pilot scale demonstration projects at the \$800,000 level for the two-year period and the remainder at or about the \$200,000 level.

### **B. Project/Award Period**

Awards are anticipated to start on September 1, 2006. Proposals may request up to two years support.

### **C. Type of Funding Instrument**

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Proposals selected for funding from non-Federal applicants will be funded through project grants or cooperative agreements. We will use cooperative agreements if the proposed project includes substantial involvement by the federal agency funding the project that will be described in the award. Examples of substantial involvement may include collaboration in research, participation in selection of key personnel, or approval of key stages in the project before subsequent steps are undertaken. Proposals selected for funding from Federal applicants will be funded through inter-agency transfers.

## **III. Eligibility Information**

### **A. Eligible Applicants**

This solicitation allows funding of proposals from institutions of higher education, other non-profits, commercial organizations, state, local and Indian tribal governments and Federal agencies. Applications from non-Federal and eligible Federal applicants (including NOAA employees) will be evaluated in the same selection process. Only those who submit preliminary proposals by the preliminary proposal deadline are eligible to submit full proposals.

## **B. Cost Sharing Or Matching Requirement**

Cost sharing or matching funds is NOT required. However, proposals that combine resources from institutions such as private industry, universities, Federal and State agencies, and foundations to address national or regional issues will be considered favorably in relation to selection factor 6 (Partnerships) listed in the Omnibus Federal Register notice for this competition.

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## **IV. Application and Submission Information**

### **A. Address to request Application Package**

Applications are available through <http://www.grants.gov>. If an applicant does not have internet access, please contact Dr. James McVey, National Sea Grant College Program, 1315 East-West Highway, R/SG, Rm 11838, Silver Spring, MD 20910; tel: (301) 713-2451 ext. 160.

### **B. Content and Form of Application Submission**

Applications must adhere to the provisions under "Format Requirements" and "Content Requirements" below by the deadline. Failure to follow these restrictions will result in applications being rejected without review.

#### **1. Format Requirements**

The number of pages in the application must be in accordance with the page limitations specified under "Content Requirements." All pages should be single-spaced and should be composed in at least a 10-point font with one-inch margins on 8½" x 11" paper.

Brevity will assist reviewers and program staff in dealing effectively with proposals. Therefore, the Project Description may not exceed 2 pages in the preliminary proposal, and 15 pages in the full proposals. Tables and visual materials, including figures, charts, graphs, maps, photographs, and other pictorial presentations, are included in the page limitation for the Project Description. As noted below, literature cited, budget information, current and pending support, resumes of investigators, and letters of support are not considered part of the Project Description and are not included in the page limitation. No other appendices are permitted. Conformance to the page limitation will be strictly enforced.

#### **2. Content Requirements – preliminary proposals**

The following information must be included:

- a. Signed Title Page: The title page must be signed by the Principal Investigator. Principal investigators and collaborators should be identified by affiliation and contact information, including, if available, email addresses. The total estimated project costs (Federal funds being requested and matching funds, if any) should be listed for each year.
- b. A concise (2-page limit) description of the project that sets the stage for the work and identifies how the research would fit into any ongoing research in this area; a rationale of why the work should be

conducted; a clear statement of objectives; and the general methodology that will be used.

- c. Resumes (1-page limit per investigator) of the Principal Investigators.

No institutional signatures or Federal government forms are needed while submitting preliminary proposals.

### **3. Content Requirements – full proposals**

The following information must be included:

- a. Signed Title Page: The title page should be signed by the Principal Investigator and the institutional representative. It should clearly identify the program area being addressed by starting the project title with: NOAA Marine Aquaculture Program. Electronic signatures submitted through [grants.gov](http://grants.gov) satisfy this requirement. Identify the Principal Investigators and collaborators and the institutional representative by affiliation and contact information. List the total amount of Federal funds being requested for each budget period; for projects involving multiple institutions, the total should include all sub-recipient budgets.
- b. Project Summary: It is critical that the project summary accurately describes the planning process being proposed and conveys all essential elements of the activities. Applicants should use the Sea Grant Project Summary Form 90-2, but may use their own form as long as it provides the following information:
  - 1. Title: Use the exact title as it appears in the rest of the application.
  - 2. Investigators: List the names and affiliations of each investigator who will significantly contribute to the project. Start with the Principal Investigator.
  - 3. Funding: Report the funding request for each year of the project, including matching funds if appropriate.
  - 4. Project Period: Give the start and completion dates. Propose a start date of September 1, 2006, or later. Project activities can extend for up to two years.
  - 5. Project objectives, methodology, and rationale: Provide a brief statement of the rationale for the project, the scientific or technical objectives and/or hypotheses to be tested, a summary of the work to be completed, and a description of how results will be documented and disseminated.
- c. Project Description (15-page limit):
  - 1. Introduction/Background/Justification: The applicant may wish to include in this section: (i) current state of knowledge; (ii) contributions that the study will make to the particular discipline or subject area; and (iii) contributions the study will make toward addressing the problems identified in the NOAA Marine Aquaculture Program.
  - 2. Research or technical plan: (i) objectives to be achieved, hypotheses to be tested; (ii) plan of work and discussion of how stated project objectives will be achieved; and (iii) role of project personnel.
  - 3. Output: Describe the project outputs that will contribute to improving and further developing marine aquaculture in the U. S.
  - 4. Coordination with other program elements: Describe any coordination with other agency programs or ongoing research efforts. Describe any other proposals that are essential to the success of this proposal.
- d. Literature Cited
- e. Budget and Budget Justification: Although proposals are funded from a single year appropriation (fiscal year 2006), project activities may



extend for up to 2 years. There should be a separate budget for each year of the project, as well as a cumulative annual budget for the entire project. Applicants are encouraged to use the Sea Grant Budget Form 90-4, but may use their own form as long as it provides the same information as the Sea Grant form. Subcontracts should have a separate budget page. Indicate matching funds and cost sharing if provided. The appropriateness of all cost sharing will be determined on the basis of guidance provided in applicable Federal cost principles. The applicants will be bound by the percentage of cost sharing reflected in the grant award. Provide justification for all budget items in sufficient detail to enable the reviewers to evaluate the appropriateness of the funding requested.

- f. Current and Pending Support: Provide information on all current and pending Federal support for ongoing projects and proposals, including subsequent funding in the case of continuing grants. Include the proposed project and all other projects or activities using Federal assistance and requiring a portion of time of the principal investigator or other senior personnel. Describe the relationship between the proposed project and these other projects, and the number of person-months per year to be devoted to the projects must be stated. Similar information must be provided for all proposals already submitted or submitted concurrently to other possible sponsors, including those within the Departments of Commerce, the Interior, and Agriculture.
- g. Resumes (2 pages maximum per investigator).
- h. Standard Application Forms: Please refer to the standard application package available through [grants.gov](http://grants.gov). Hard copies can be received from Geri Taylor, National Sea Grant College Program, 1315 East-West Highway, R/SG, Rm 11732, Silver Spring, MD 20910; tel: (301) 713-2445 ext. 137.

### **C. Submission Dates And Times**

Preliminary proposals must be received by 4 p.m. EST on Tuesday, February 28, 2006. Full proposals must be received by 4 p.m. EST on Thursday, April 13, 2006. Notice of encouragement for preliminary proposals to be developed into full proposals should be provided on or about March 10, 2006. Submissions through [grants.gov](http://grants.gov) will have a date and time indicator on them. Hard copies will be date and time stamped upon receipt. Applications that are not received by the deadline will not be reviewed.

### **D. Intergovernmental Review**

Applications under this program are not subject to Executive Order 12372, "Intergovernmental Review of Federal Programs."

### **E. Funding Restrictions**

No special restrictions apply.

### **F. Other Submission Requirements**

Preliminary proposals should be submitted as hard copy to: NOAA, National Sea Grant College Program, R/SG, Attn: Dr. James McVey, Room 11838, 1315 East-West Highway, Silver Spring, MD 20910 (phone number for express mail applications is 301-713-2435).

Full proposals should be submitted to [grants.gov](http://grants.gov). Applicants for whom online application is an undue hardship may submit hard copies (an original

and two copies) to: National Sea Grant College Program, R/SG, Attn: Dr. James McVey, Rm 11838, NOAA, 1315 East-West Highway, Silver Spring, MD 20910.

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## **V. Application Review Information**

### **A. Evaluation Criteria**

The five evaluation criteria and weighting of the criteria are as follows:

1. Importance and/or relevance and applicability of proposed project to the program goals (45 percent). This ascertains whether there is intrinsic value in the proposed work and/or relevance to NOAA, Federal, regional, State, or local activities. For this competition, this criterion ascertains the significance of the problem relative to the priorities listed in this announcement, and the degree to which the activity, if successful, will increase domestic marine aquaculture production, and advance the state of the industry, science, or state-of-the-art methods for marine aquaculture
2. Technical/scientific merit (35 percent). This assesses whether the approach is technically sound and/or innovative, if the methods are appropriate, and whether there are clear project goals and objectives. For this competition, this criterion assesses the level of scientific endeavor or professional merit exhibited in the proposal and the presence of a clear work plan, and probability of success. This criterion will also include an evaluation of the unique combination of technologies and disciplines to overcome a significant problem.
3. Overall qualifications of applicants (10 percent). This ascertains whether the applicant possesses the necessary education, experience, training, facilities, and administrative resources to accomplish the project.
4. Project costs (5 percent). The Budget is evaluated to determine if it is realistic and commensurate with the project needs and time-frame. For this competition, this criterion also assesses whether the requested budget is consistent with the proposed activities.
5. Outreach and education (5 percent). NOAA assesses whether this project provides a focused and effective education and outreach strategy regarding NOAA's mission to protect the Nation's natural resources. For this competition, this criterion assesses the likelihood of substantial public engagement in the planning process and whether the plan will be communicated effectively to stakeholders and potential sources of funding support?

### **B. Review And Selection Process**

An initial administrative review is conducted to determine compliance with requirements and completeness of the application.

Preliminary proposals and full proposals will be subjected to peer review based on the evaluation criteria listed above. A peer review panel consisting of government, academic, and industry representatives will evaluate each proposal. The preproposal process will be used to identify those applications most likely to be successful in the competition. Applicants will receive written comments for both preproposals and full proposals. Any applicant who has submitted a preproposal by the deadline is eligible to submit a full proposal.

The Program Coordinator will review the ranking of the proposals and the



review comments and make recommendations to the NOAA Aquaculture Program. The average numerical ranking from the review process will be the primary consideration in deciding which of the proposals will be recommended for funding to the NOAA Grants Officer. Awards will be selected in rank order unless the proposal is justified to be selected out of rank order based upon any of the following factors described in the next section.

### **C. Selection Factors**

The Sea Grant Director will award in rank order unless the proposal is justified to be selected out of rank order based upon one or more of the following factors:

1. Availability of funding
2. Balance/distribution of funds
  - a. Geographically
  - b. By type of institutions
  - c. By type of partners
  - d. By research areas
  - e. By project types
3. Duplication of other projects funded or considered for funding by NOAA or other Federal agencies
4. Program priorities and policy factors
5. Applicant's prior award performance
6. Partnerships and/or Participation of targeted groups
7. Adequacy of information necessary for NOAA staff to make a NEPA determination and draft necessary documentation before recommendations for funding are made to the Grants Officer.

For Selection Factor 4, the program priorities and policy factors are set out in Section 1.B. Selection Factor 5 includes reporting of results.

Applicants may be asked to respond to questions or modify objectives, work plans, or budgets prior to final approval of the award. Subsequent grant administration procedures will be in accordance with current agency grants procedures. A summary statement of the evaluation by the review panel will be provided to each applicant.

### **D. Anticipated Announcement and Award Dates**

Subject to the availability of funds, awards are expected to be made by September 1, 2006, this start date that should be used on the Application for Federal Assistance (Form 424) for successful applications.

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## **VI. Award Administration Information**

### **A. Award Notices**

The notice of award is signed by the NOAA Grants Officer and is the authorizing document. It is provided by either electronic or postal mail to the appropriate business office of the recipient organization.

### **B. Administrative and National Policy Requirements**

Limitation of Liability. In no event will NOAA or the Department of Commerce be responsible for proposal preparation costs if these programs

are cancelled because of other agency priorities. Publication of this announcement does not oblige NOAA to award any specific project or to provide special fishing privileges.

National Environmental Policy Act (NEPA). NOAA must analyze the potential environmental impacts, as required by the National Environmental Policy Act (NEPA), for applicant projects or proposals which are seeking NOAA federal funding opportunities. Detailed information on NOAA compliance with NEPA can be found at the following NOAA NEPA website: <http://www.nepa.noaa.gov/>, including our NOAA Administrative Order 216-6 for NEPA, [http://www.nepa.noaa.gov/NAO216\\_6\\_TOC.pdf](http://www.nepa.noaa.gov/NAO216_6_TOC.pdf), and the Council on Environmental Quality implementation regulations, [http://ceq.eh.doe.gov/nepa/regs/ceq/toc\\_ceq.htm](http://ceq.eh.doe.gov/nepa/regs/ceq/toc_ceq.htm) Consequently, as part of an applicant's package, and under their description of their program activities, applicants are required to provide detailed information on the activities to be conducted, locations, sites, species and habitat to be affected, possible construction activities, and any environmental concerns that may exist (e. g., the use and disposal of hazardous or toxic chemicals, introduction of non-indigenous species, impacts to endangered and threatened species, aquaculture projects, and impacts to coral reef systems). In addition to providing specific information that will serve as the basis for any required impact analyses, applicants may also be requested to assist NOAA in drafting of an environmental assessment, if NOAA determines an assessment is required. Applicants will also be required to cooperate with NOAA in identifying feasible measures to reduce or avoid any identified adverse environmental impacts of their proposal. The failure to do so shall be grounds for not selecting an application. In some cases if additional information is required after an application is selected, funds can be withheld by the Grants Officer under a special award condition requiring the recipient to submit additional environmental compliance information sufficient to enable NOAA to make an assessment on any impacts that a project may have on the environment

The Department of Commerce Pre-Award Notification Requirements for Grants and Cooperative Agreements. The Department of Commerce Pre-Award Notification Requirements for Grants and Cooperative Agreements contained in the Federal Register notice of December 30, 2004 (69 FR 78389), are applicable to this solicitation.

### **C. Reporting**

Financial reports are to be submitted to the NOAA Grants Officer and performance reports (summary of accomplishments and activities) are to be submitted to Dr. James McVey (see address below). Electronic submission of reports is preferred. All hard copy financial and progress reports shall be submitted in triplicate (one original and two copies). Financial reports are semi-annual and performance reports are annual.

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### **VII. Agency Contact(s)**

Contact Dr. James McVey, National Sea Grant College Program, 1315 East-West Highway, R/SG, Rm 11838, Silver Spring, MD 20910; tel: (301) 713-2451 ext. 160; e-mail: [jim.mcvey@noaa.gov](mailto:jim.mcvey@noaa.gov)

Ms. Megan Agy, National Sea Grant College Program, 1315 East-West Highway, R/SG, Silver Spring, MD 20910; tel: (301) 713-2431; e-mail: [megan.agy@noaa.gov](mailto:megan.agy@noaa.gov)

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## National Marine Aquaculture Initiative Projects by TOPIC

The National Oceanic and Atmospheric Administration (NOAA) launched the National Marine Aquaculture Initiative (NMAI) in 1998, to help resolve the issues standing in the way of the development of a marine aquaculture industry. Since its launch, NMAI has provided \$10.5 million of funding to competitively selected projects. These projects address a broad range of topics, including aquaculture policy and regulation, offshore aquaculture, marine recirculating systems, shellfish farming, and new species research. To view specific projects by TOPIC, click on the headings below.

### [Shellfish Aquaculture](#)

Shellfish aquaculture involves farming invertebrates such as clams, mussels, oysters, and scallops. Shellfish aquaculture can help to meet an increasing demand for seafood in the U.S. while providing a closely-related field of employment for shell fishermen displaced by declines in wild shellfish stocks. NMAI projects listed under this topic focus on developing technologies and innovations for farming shellfish.

### [Finfish Aquaculture](#)

Finfish aquaculture involves raising fish such as cobia, mutton snapper, and sea bass. Projects appearing under this topic focus on developing technologies and innovations for farming finfish.

### [Open Ocean or Offshore Aquaculture](#)

Offshore or open ocean aquaculture is a form of marine aquaculture where finfish or shellfish are farmed from sites located in the open ocean, several miles from the coast. In the United States, this type of aquaculture is still in its infancy, but does hold promise for farming both finfish and shellfish. NMAI projects listed under this topic are designed to provide opportunities for growth of the U.S. offshore aquaculture industry.

### [Marine Recirculating Systems](#)

Marine recirculating aquaculture systems, also known as water reuse systems, reuse water by passing it through a filtration system that removes fish waste and contaminants. Compared to traditional aquaculture practices that use large quantities of high-quality water, recirculating aquaculture systems use less water and land and yet produce similar yields. Recirculating aquaculture currently has a higher production cost than traditional non-recirculating aquaculture. NMAI-funded projects listed under this topic work to develop new and innovative technologies needed to make marine recirculating aquaculture operations more competitive.

### [Hatchery and Nursery Development](#)

Without young fish to raise, an aquaculture program will have little success. There are typically three stages involved in fish farming: the hatchery

(where fish eggs are collected, fertilized, and hatched), the nursery (where recently hatched fish are allowed to grow to juvenile size), and the actual farm (where juveniles grow to market size). In order for an aquaculture program to be successful, it must have access to juvenile fish that can be grown to market size. Projects listed under this topic address hatchery and nursery development, including things such as breeding programs, cost-effective food for juveniles, and transport of juveniles to cages where they can be grown to market size.

### **Nutrition and Health**

The health, nutrition, and food quality of organisms being raised in marine aquaculture programs can impact the success of the program. Food content can also impact the surrounding environment. NMAI-funded projects that fall under this topic are exploring nutrition and health management and technologies, including things such as the development of high-protein foods and vaccines for fish to control the spread of disease.

### **Best Management Practices**

Operating procedures, schedules of activities, maintenance procedures, and other management practices are needed in order to minimize the environmental impacts of marine aquaculture operations while maximizing economic outputs from these operations. Projects listed here are working towards building effective management practices that can be put to use.

### **Environmental Monitoring and Protection**

As the U.S. marine aquaculture industry continues to develop, management practices and technologies are needed that minimize environmental impacts to the water column, seafloor, and nearby aquatic life. Included under this topic are projects that seek to assess the environmental impacts of aquaculture and to develop new technologies to monitor and mitigate environmental changes associated with aquaculture.

### **Policy Development**

In the United States, freshwater aquaculture is more common than marine aquaculture. Within the realm of marine aquaculture, policy frameworks are needed to ensure that activities occur in an environmentally responsible way. This is especially true with respect to offshore or open ocean aquaculture, which would occur in the U.S. Exclusive Economic Zone, where there is no clear legislation governing aquaculture activities. Projects in this group seek to evaluate and develop policies to regulate marine aquaculture activities.

### **Outreach Activities and Programs**

Involvement from representatives from academic institutions, government agencies, non-governmental organizations, private industry, and the general public is key to developing aquaculture programs that are economically, socially, and environmentally sound. Projects listed under this topic aim to engage and educate constituents and community members about marine aquaculture.

### **Geographic Information System Tools**

Tools such as geographic information system (GIS) databases can be used

to find suitable locations for aquaculture operations, and ensure that these operations are not negatively impacting the environment. Using such tools can increase the likelihood that an aquaculture program will maximize economic output without negatively disrupting the environment. Projects described under this topic involve the development and implementation of GIS and other tools to analyze data and help in making reliable aquaculture decisions.

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## Shellfish Aquaculture

Shellfish aquaculture involves farming invertebrates such as clams, mussels, oysters, and scallops. Shellfish aquaculture can help to meet an increasing demand for seafood in the U.S. while providing a closely-related field of employment for shell fishermen displaced by declines in wild shellfish stocks. NMAI-funded projects listed on this page focus on developing technologies and innovations for farming shellfish.

Projects are listed chronologically, starting with those projects that received funding in fiscal year (FY) 2004.

### **High rate algal systems for sustainable marine bivalve seed and shrimp co-production.**

This project explores ways to maintain a high density of algae in waters used to farm shrimp. High algal growth stimulates oxygen production and nutrient uptake. The studied technique offers the advantages of "greenwater production" at productivities higher than those obtained with conventional, intensive aquaculture systems, while avoiding the high cost of conventional techniques. Led by Clemson University in South Carolina. (FY 2004)

### **Environmental and technical assessment of alternative shellfish production methods.**

Researchers are studying the environmental and technical aspects of cage and bag-on-bottom, bag-on-rack, and bottom-suspended oyster and clam culture in the Pacific Northwest. Led by local shellfish growers, the Pacific Shellfish Institute, the Pacific Coast Shellfish Growers Association, the Connecticut Sea Grant Extension Program, the Massachusetts Institute of Technology, and the Virginia Institute of Marine Science. (FY 2004)

### **Ecological characteristics and carrying capacity of suspended shellfish culture systems.**

The goal of this study is to determine the impact of shellfish cultured in an intensive raft culture system on the surrounding environment. Researchers will examine the relationships between oceanographic and physiological processes and nutrient loading and ecosystem function associated with the culture system. Led by the Pacific Shellfish Institute, Taylor Resources, Inc., the Aquatic Environmental Science Lab, the University of Washington, and Northwest Research Associates. (FY 2001-2002)

### **Quantifying impacts of clam culture on adjacent communities.**

This work examines the impact of clam culture in an aquaculture lease area on adjacent communities, which include shallow water soft bottoms, salt marsh, oyster bars, and sea grass beds. Researchers will collect baseline data prior to the initiation of clam culture and will quantify any impacts once leases are stocked. Project results will be used for improved management of aquaculture leases and, if necessary, to refine Florida's

Aquaculture Best Management Practices. Led by the Florida Department of Agriculture and Consumer Services. (FY 2001-2002)

**Engineered ecosystems for high rate sustainable marine shrimp and bivalve production.**

The overall goal of this project is to adapt and demonstrate a prototype marine aquaculture system to farm high-value marine shrimp and marine bivalves, with reduced resource inputs and reduced or eliminated environmental impact. Led by Clemson University and Atlantic Aquafarms. (FY 2001-2002)

**Developing environmental codes of practice for the Pacific coast shellfish industry.**

This project seeks to establish an environmental code of practice for shellfish growers along the Pacific coast. This code of practice will implement the environmental policy statement already drafted by the Pacific coast shellfish aquaculture industry as a component of the effort to develop an environmental management system for shellfish aquaculture on the Pacific coast. Led by the Pacific Coast Shellfish Growers' Association and a local grower. (FY 2000)

**Triploid-tetraploid technology for hard clam aquaculture.**

Triploid shellfish, which have three sets of chromosomes, are superior stocks for aquaculture because of their sterility, superior growth, and improved meat quality. Tetraploids shellfish have four sets of chromosomes and are valuable because they produce genetically superior triploids when mated with normal shellfish. The overall goal of this project is to enhance hard clam aquaculture along the Atlantic coast through the development and introduction of the triploid-tetraploid technology. Led by Rutgers University's Haskin Shellfish Research Laboratory. (FY 1999)

**Application of Hazard Analysis and Critical Control Point (HACCP) principles as a risk management approach for exotic pathogen control in aquaculture.**

This project applied Hazard Analysis Critical Control Point (HAACP) principles as a risk management approach to control the risk of viral disease transfer to and/or from shrimp aquaculture production and processing facilities. This approach can reduce the potential for negative impacts to wild resources and aquaculture stocks. As a result of the project, a risk management plan and appropriate models were developed. Led by the Virginia Seafood Agricultural Research and Extension Center. (FY 1999)

**Aquaculture of the Florida bay scallop in Crystal River, Florida.**

This project is developing scallop aquaculture technology as a viable alternative for fishermen who have been displaced by Florida's net ban. Led by the University of South Florida and the Florida Sea Grant Extension Program. (FY 1999)

**Development of bay scallop stock enhancement technology.**

This project is advancing hatchery-release technology to replenish bay scallop populations on the west coast of Florida. A goal of the project is also to test the relative efficiency of cage versus free-planting cultured scallops in the field. Led by Mote Marine Laboratory. (FY 1999)

### **Development of a domesticated, Specific-Pathogen-Free (SPF) breeding line of *Penaeus chinensis* for aquaculture use in the U.S.**

This project seeks to breed, develop, and rear a domesticated, specific-pathogen-free line of shrimp for aquaculture in the U.S. Led by the University of Arizona and the University of Texas, in cooperation with the Yellow Sea Marine Fisheries Research Institute in Qingdao, China. (FY 1999)

### **Genetic engineering of shrimp cell lines with pantropic retroviral vector.**

This project is improving the competitiveness of shrimp aquaculture in the U. S. by developing a technology that can lead to solutions for infectious diseases that plague the industry. Led by the University of California's Department of Pediatrics and the shrimp industry. (FY 1999)

## **Finfish Aquaculture Projects**

Finfish aquaculture involves raising fish such as cobia, mutton snapper, and sea bass. Projects appearing under this topic focus on developing technologies and innovations for farming finfish.

Projects are listed chronologically, starting with those projects that received funding in fiscal year (FY) 2004.

### **Demonstrating hatchery and offshore growout technology for production of *Cobia Rachycentron canadum* and Florida Pompano (*Trachinotus carolinus*) from egg to market.**

This project uses emerging technology to demonstrate the environmental sustainability and economic viability of raising hatchery-reared cobia in collaboration with the private sector using submerged cages in Puerto Rico and the Bahamas. Results of the project suggest that growing cobia in sites with adequate water depth and currents can produce high yields of seafood for human consumption with low environmental impact. Led by researchers at the University of Miami and in Puerto Rico, the Bahamas, and Brazil. (FY 2004)

### **Beneficial floating reef effects of marine finfish mariculture.**

This project aims to identify and measure colonizing plants and animals that grow on nets, lines, and floats at marine finfish farms in the Pacific Northwest. Data from the project will help in understanding the impacts and/or benefits of floating aquaculture systems to bottom-dwelling plant and animal populations. Led by Rensel Associates Aquatic Science Consultants and Forster Consulting, Inc. (FY 2004)

### **Measurement of the benthic loading and the benthic impact from an open-ocean fish farm in tropical waters.**

This project involves measuring the environmental impact of an open ocean fish farm on sediments and bottom water in the tropical waters of Puerto Rico and Florida. A goal of the project is also to demonstrate that, in the tropics, the abundance of microalgae can be used to signal excess nutrients in the water column (a condition known as "eutrophication"). Led by the University of Puerto Rico, the University of Miami, and NOAA Fisheries Service. (FY 2004)

## **The Hawaii offshore aquaculture research project phase IV: Scale up to carrying capacity in the offshore environment.**

In the fifth phase of the Hawaii offshore aquaculture research project, researchers are exploring hatchery technologies to secure commercial scale numbers of marine finfish fingerlings. Researchers are also monitoring the environmental effects and carrying capacity of open ocean cage farms for use in development of best management practices and regulatory oversight. These efforts are critical to making marine finfish aquaculture both economically and environmentally sustainable in the U.S. Led by the University of Hawaii and Cates International. (FY 2004)

## **Using sable fish to create a technical base for marine fish aquaculture in the Pacific Northwest.**

The long-term objective of this project is to develop a viable aquaculture system for the production of sablefish with the Makah Tribe. Researchers will test pilot-scale systems for juvenile production, develop cost-effective and sustainable feed ingredients, and develop environmentally sound methods for growing fish to market size. Led by the NOAA Northwest Fisheries Science Center, the University of Washington, Makah Tribal Fisheries, Spar Technologies, Supreme Alaskan Seafoods, and the Aquaseed Corporation. (FY 2001-2002)

## **An integrated approach to the development of cobia (*Rachycentron canadum*) culture in the United States.**

This project seeks to develop an integrated approach to the commercial production of cobia culture in the United States. Specifically, researchers are exploring the nutritional, health, and environmental needs of commercial-scale cobia from the hatchery to the fish farm. Results from this project contributed to one of the most rapid commercialization of a new culture species ever witnessed: from no commercial production to potentially hundreds of thousands of pounds in just a couple years. Led by the Virginia Institute of Marine Science, the University of Texas, the University of Southern Mississippi, Southland Fisheries Corporation, the South Carolina Department of Natural Resources, and Fins Technology. (FY 2001-2002)

## **Development of reliable spawning, nursery and juvenile production techniques for commercialization of black sea bass aquaculture.**

Identification of new aquaculture species is critical for the U.S. industry to continue to expand. Recent work with black sea bass suggests that this species has characteristics which make it an excellent candidate for commercial development. The goal of this project is to establish a commercial aquaculture industry for black sea bass by improving the predictability of spawning and developing protocols for the commercial-scale production of juveniles. Led by South Carolina Marine Resources Research, the University of New Hampshire, Clemson University, the University of North Carolina, Texas A&M University, NOAA Ocean Service, the Waddell Mariculture Center, South Carolina Sea Grant Extension, Southland Fisheries, Swimming Rock Fish and Shrimp Company, and Great Bay Aquafarms, Inc. (FY 2001-2002)

## **Hatchery production of mutton snapper (*Lutjanus analis*) and other high value marine food fish.**

The main objective of this project is to refine and implement reliable

techniques of controlled reproduction and growth of larval mutton snapper, greater amberjack, and other marine fish. Reaching this objective will make large-scale production of fingerlings possible. Project accomplishments have included the successful development of hatchery technology, breeding programs, and larval rearing techniques for cobia and mutton snapper. Led by researchers from the University of Miami, Florida International University, North Carolina State University, Southland Fisheries Corporation, the University of Miami, and Florida Keys Community College, as well as several private consultants. (FY 2001-2002)

**Development of methods for the production of effective micro-particulate feeds for marine fish larvae.**

The overall objective of this project is to develop food capable of supporting the growth and development of marine fish larvae. Formulated diets for marine fish larvae can reduce dependency on live food and improve success in larval growth. Led by Oregon State University, the NOAA Northwest Fisheries Center, and the U.S. Fish and Wildlife Service. (FY 2001-2002)

**Development of large-scale rearing methods for the continuous culture of marine copepods.**

Copepods are the live feed that results in the highest growth and development of fish larvae. Fish fed copepods have been consistently shown to grow faster and develop sooner than fish fed a diet of other small organisms. The overall aim of this project is to develop a culture system for the large-scale production of copepods at the minimum level for economic feasibility. Led by North Carolina State University, Great Bay Aquafarms, and the U.S. Department of Agriculture-Agriculture Research Service. (FY 2001-2002)

**Determination of dietary requirements for cultured summer flounder (*Paralichthys dentatus*) for enhancement of aquaculture potential.**

This project addresses nutritional problems with currently available commercial diets for juvenile summer flounder by investigating basic nutritional requirements for this species. Research will focus on determining the optimal dietary levels that will support maximum weight gain, optimal health, and desirable final body compositional traits in this species. Led by Virginia Tech, the Virginia Seafood Agricultural Research and Extension Center, and Virginia Tech's Veterinary School. (FY 2001-2002)

**Balanced ecosystems management for the development of sustainable offshore aquaculture in the Gulf of Mexico.**

This project aims to develop socially and environmentally acceptable offshore aquaculture for the Gulf of Mexico region. A Proposed Offshore Aquaculture Consortium (OAC) research and demonstration project will be conducted in a manner similar to a commercial-scale offshore aquaculture operation (i.e., feeding, net cleaning, mortality removal, fish size/health sampling). Led by researchers from the University of Southern Mississippi, Texas A&M University, Massachusetts Institute of Technology, Mississippi State University, NOAA Fisheries Service, Ocean Spar Technologies, Land of Lakes Farmland Feed, Good Streak Marine, the Mississippi/Alabama Sea Grant Program, Auburn University, the University of Kiel, and Texas Parks and Wildlife. (FY 2001-2002)

**Offshore finfish mariculture in the Western Strait of Juan de Fuca, Washington State.**

This project focuses on the development of environmental data to support permit applications by interested investors for offshore net-pen finfish aquaculture in northwest Washington. It will use environmental modeling and a geographic information systems (GIS) program for data analyses and presentation. Project reports and work products will help the Washington Fish Growers Association, the Washington State Department of Natural Resources, and the Makah Tribe to develop finfish aquaculture in the Juan de Fuca Straits. Led by the Washington Sea Grant Program, Rensel Associates, Battelle Marine Science Lab, the University of Southern California, Bellweather Consulting, the Washington Fish Growers Association, the Washington Department of Natural Resources, the Washington Department of Ecology, the Washington Department of Fish and Wildlife, the Makah Tribal Nation, and several private consultants. (FY 2001-2002)

### **Hawaii offshore aquaculture research Project (HOARP) Phase III: Critical research and development issues for commercialization.**

In this phase of the project to develop offshore aquaculture in Hawaii, researchers are focusing on assessing the short and long-term environmental effects of a tropical open ocean culture farm with multiple cages. Led by the University of Hawaii, Oceanic Institute, and Cates International. (FY 2001-2002)

### **Development of an integrated recirculating aquaculture system for nutrient bioremediation in urban aquaculture.**

The goal of this project is to develop a of a relatively small-scale finfish/seaweed recirculating aquaculture system suitable for urban aquaculture and to develop financial models to allow funding of startup business planning to use the system in urban areas. Led by the University of Connecticut, the State University of New York, the University of New Brunswick, the University of New Hampshire, Great Bay Aquafarms, and the Bridgeport Regional Vocational School. (FY 2001-2002)

### **Environmental impact of sustainable offshore cage culture production in Puerto Rican waters.**

The overall goal of this project is to determine the environmental, economical, and social impact of finfish offshore cage culture on tropical marine waters located near Puerto Rico. The environmental component will evaluate the impact of cage culture on the chemical, physical, and biological variables in the area surrounding the commercial-scale operation. The project will evaluate negative and positive perceptions and attitudes, support from the community, potential vandalism, and poaching. Possible conflicts with the fisheries industry, tourism, and boat traffic will also be analyzed. Led by the Puerto Rican Commercial Aquaculture Research and Development Center and the University of Miami. (FY 2001-2002)

### **A code of conduct for net-pen salmon farming.**

This project will establish a Code of Conduct for net-pen farming in the Pacific northwest. Experts from NOAA's National Marine Fisheries Service and regional stakeholders will evaluate the risks and benefits of net-pen farming in the region and, with the Washington Fish Growers' Association, will use this scientific, technical, and regulatory information to produce the code. To view the resulting code of conduct, [click here](#). Led by the Washington Fishgrowers' Association and NOAA National Marine Fisheries Service. (FY 2000)



### **Captive spawning, larval and early juvenile culture of cobia.**

The goal of this project was to develop a process for successful captive culture of cobia. The project has resulted in the successful spawning of healthy cobia eggs in captivity, followed by fertilization and growth of larval and juvenile stages. Protocols were developed for the acquisition, handling, and transport of wild-harvested fish to a finfish aquaculture facility. Raised cobia received high marks in taste tests. Led by the Virginia Institute of Marine Science. (FY 1999)

### **Technology transfer to establish black sea bass aquaculture as a commercial reality.**

This project focused on hatchery and nursery techniques for the production of larval and juvenile black sea bass, to make aquaculture of this species commercially viable. Led by the South Carolina Sea Grant Consortium. (FY 1999)

### **Commercial hatchery production of mutton snapper (*Lutjanus analis*) and greater amberjack (*Seriola dumerili*) for growout in offshore cage systems.**

This project focused on developing hatchery technology for the development of commercial tropical marine fish offshore aquaculture in the U.S., especially in the Gulf of Mexico and the Caribbean regions. As a result of the project, offshore aquaculture operations to farm mutton snapper, greater amberjack, and cobia are underway or in development. Led by the University of Miami. (FY 1999)

### **Biological engineering, environmental and legal research for the development of offshore cage aquaculture in the Gulf of Mexico.**

This project is monitoring fish behavior using the cage system as a fish aggregating device, while also evaluating the ecological impact of the system on wild fish. The legal research portion of the project investigated the legal and regulatory basis of offshore cage and oil/gas platform-based aquaculture in the five Gulf states. To view a report resulting from the project, [click here](#). Led by the Mississippi-Alabama Sea Grant Consortium, the Texas Sea Grant College Program, and the Massachusetts Institute of Technology Sea Grant College Program. (FY 1999)

### **Use of emerging marine recirculating technologies to establish commercial production of high-value marine species.**

This project is working to establish commercial production of the marine finfish pompano through the use of modern marine recirculating technologies. While the development of pompano as a candidate fish for production aquaculture is still in its earliest stages, preliminary project results are encouraging. Led by Louisiana State University's Aquaculture Research Station and the Louisiana Universities Marine Consortium. (FY 1999)

### **Hawaii Offshore Aquaculture Research Project (HOARP) Phase II.**

This project is targeted to continue efforts on demonstration of offshore culture and harvest of Pacific threadfin in a submersible sea-cage located off the coast of Hawaii. This phase of the project resulted in doubling of sea-cage pre-harvest density, evaluating the cage as a fish aggregation device,

determining cage impacts on water quality and benthic community structure, and estimating the economics of production. Led by the University of Hawaii and Cates International. (FY 1999)

## **Offshore or Open Ocean Aquaculture Projects**

Offshore or open ocean aquaculture is a form of marine aquaculture where finfish or shellfish are farmed from sites located in the open ocean, several miles from the coast. In the United States, this type of aquaculture is still in its infancy, but does hold promise for farming both finfish and shellfish. Projects listed on this page are designed to provide opportunities for growth of the U.S. offshore aquaculture industry.

Projects are listed chronologically, starting with those projects that received funding in fiscal year (FY) 2004.

### **Demonstrating hatchery and offshore growout technology for production of Cobia *Rachycentron canadum* and Florida Pompano (*Trachinotus carolinus*) from egg to market.**

This project uses emerging technology to demonstrate the environmental sustainability and economic viability of raising hatchery-reared cobia in collaboration with the private sector using submerged cages in Puerto Rico and the Bahamas. Results of the project suggest that growing cobia in sites with adequate water depth and currents can produce high yields of seafood for human consumption with low environmental impact. Led by researchers at the University of Miami and in Puerto Rico, the Bahamas, and Brazil. (FY 2004)

### **Measurement of the benthic loading and the benthic impact from an open-ocean fish farm in tropical waters.**

This project involves measuring the environmental impact of an open ocean fish farm on sediments and bottom water in the tropical waters of Puerto Rico and Florida. A goal of the project is also to demonstrate that, in the tropics, the abundance of microalgae can be used to signal excess nutrients in the water column (a condition known as "eutrophication"). Led by the University of Puerto Rico, the University of Miami, and NOAA Fisheries Service. (FY 2004)

### **The Hawaii offshore aquaculture research project phase IV: Scale up to carrying capacity in the offshore environment.**

In the fifth phase of the Hawaii offshore aquaculture research project, researchers are exploring hatchery technologies to secure commercial scale numbers of marine finfish fingerlings. Researchers are also monitoring the environmental effects and carrying capacity of open ocean cage farms for use in development of best management practices and regulatory oversight. These efforts are critical to making marine finfish aquaculture both economically and environmentally sustainable in the U.S. Led by the University of Hawaii and Cates International. (FY 2004)

### **Balanced ecosystems management for the development of sustainable offshore aquaculture in the Gulf of Mexico.**

This project aims to develop socially and environmentally acceptable offshore aquaculture for the Gulf of Mexico region. A Proposed Offshore Aquaculture Consortium (OAC) research and demonstration project will be conducted in a manner similar to a commercial-scale offshore aquaculture

operation (i.e., feeding, net cleaning, mortality removal, fish size/health sampling). Led by researchers from the University of Southern Mississippi, Texas A&M University, Massachusetts Institute of Technology, Mississippi State University, NOAA Fisheries Service, Ocean Spar Technologies, Land of Lakes Farmland Feed, Good Streak Marine, the Mississippi/Alabama Sea Grant Program, Auburn University, the University of Kiel, and Texas Parks and Wildlife. (FY 2001-2002)

### **Offshore finfish mariculture in the Western Strait of Juan de Fuca, Washington State.**

This project focuses on the development of environmental data to support permit applications by interested investors for offshore net-pen finfish aquaculture in northwest Washington. It will use environmental modeling and a geographic information systems (GIS) program for data analyses and presentation. Project reports and work products will help the Washington Fish Growers Association, the Washington State Department of Natural Resources, and the Makah Tribe to develop finfish aquaculture in the Juan de Fuca Straits. Led by the Washington Sea Grant Program, Rensel Associates, Battelle Marine Science Lab, the University of Southern California, Bellweather Consulting, the Washington Fish Growers Association, the Washington Department of Natural Resources, the Washington Department of Ecology, the Washington Department of Fish and Wildlife, the Makah Tribal Nation, and several private consultants. (FY 2001-2002)

### **Hawaii offshore aquaculture research Project (HOARP) Phase III: Critical research and development issues for commercialization.**

In this phase of the project to develop offshore aquaculture in Hawaii, researchers are focusing on assessing the short and long-term environmental effects of a tropical open ocean culture farm with multiple cages. Led by the University of Hawaii, Oceanic Institute, and Cates International. (FY 2001-2002)

### **Environmental impact of sustainable offshore cage culture production in Puerto Rican waters.**

The overall goal of this project is to determine the environmental, economical, and social impact of finfish offshore cage culture on tropical marine waters located near Puerto Rico. The environmental component will evaluate the impact of cage culture on the chemical, physical, and biological variables in the area surrounding the commercial-scale operation. The project will evaluate negative and positive perceptions and attitudes, support from the community, potential vandalism, and poaching. Possible conflicts with the fisheries industry, tourism, and boat traffic will also be analyzed. Led by the Puerto Rican Commercial Aquaculture Research and Development Center and the University of Miami. (FY 2001-2002)

### **Development and testing of an operational framework for offshore aquaculture in conjunction with stakeholders at national and regional levels.**

Building on the work from a previously funded project by Sea Grant, this project team will work with stakeholders at national and regional levels to develop and test an operational framework for offshore aquaculture. The team will focus on procedures for planning and site assessment for aquaculture operations in the 200-mile ocean zone, joint state/federal permitting process for aquaculture, guidelines and standards for the environmental review process, guidelines and standards for issuance leases,

and monitoring guidelines. Led by the University of Delaware, NOAA Fisheries Service, the State of Hawaii, South Carolina Sea Grant, the Delaware Aquaculture Resource Center, the Sea Grant Law Center, the Policy Center for Marine Bioscience and Technology at the University of Massachusetts, the Coastal States Organization, Texas Sea Grant, Moonstone Oysters, Sea Web, and several private consultants. (FY 2001-2002)

### **Using GIS for offshore aquaculture siting in the U.S. Caribbean and Florida.**

This project will design and construct a geographic information system (GIS)-based decision support tool to allow optimal location of caged aquaculture projects planned for offshore Florida, Puerto Rico and the U.S. Virgin Islands. Led by the University of Miami, NOAA Fisheries Service, the Florida Department of Agriculture—DNER/Marine Resources Division, and Puerto Rico's Coastal Zone Program. (FY 2001-2002)

### **Identification and mitigation of legal and regulatory hurdles to offshore aquaculture in the Gulf of Mexico.**

This project seeks to identify and mitigate the legal and regulatory hurdles to offshore aquaculture in the Gulf of Mexico. The project is the beginning of a multi-phased effort to develop an efficient and transparent permitting process and to produce a user-friendly guide to aquaculture siting and permitting in the U.S. Exclusive Economic Zone (EEZ). Led by Texas, Louisiana, and Mississippi-Alabama Sea Grant Programs. (FY 2000)

### **Evaluating open ocean aquaculture sites using GIS and regulatory processes in Hawaii.**

This project will identify offshore sites among the main islands of Hawaii that will be suitable for marine aquaculture and subsequent development of open ocean aquaculture parks by incorporating existing federal, university, and state oceanographic data sets into a geographic information system. Led by the University of Hawaii. (FY 2000)

### **Reducing the risk of open-ocean aquaculture facilities to protected species.**

This project, which was to be completed in 2001, sought to develop a transmitting buoy that would be activated by an entangled large marine mammal. A whale would put excessive stresses on a submerged long-line mussel aquaculture mooring, break a weak line, and would trigger a release to allow a submerged telemetry buoy to surface. Once at the surface, the buoy would start transmitting a distress signal to alert personnel that a mammal had been entangled. Led by Woods Hole Oceanographic Institution. (FY 1999)

### **A policy framework for offshore marine aquaculture in the 3-200 mile U.S. ocean zone.**

This project produced the first comprehensive assessment of federal policy with respect to the development of aquaculture as a new ocean industry in federally controlled waters off the U.S. coast. The proposed policy framework addresses the full life-cycle of offshore aquaculture projects and advocates the development of an overall policy for planning and governing all activities in the U.S. Exclusive Economic Zone, including aquaculture. Led by the University of Delaware. (FY 1999)

## **Commercial hatchery production of mutton snapper (*Lutjanus analis*) and greater amberjack (*Seriola dumerili*) for growout in offshore cage systems.**

This project focused on developing hatchery technology for the development of commercial tropical marine fish offshore aquaculture in the U.S., especially in the Gulf of Mexico and the Caribbean regions. As a result of the project, offshore aquaculture operations to farm mutton snapper, greater amberjack, and cobia are underway or in development. Led by the University of Miami. (FY 1999)

## **Biological engineering, environmental and legal research for the development of offshore cage aquaculture in the Gulf of Mexico.**

This project is monitoring fish behavior using the cage system as a fish aggregating device, while also evaluating the ecological impact of the system on wild fish. The legal research portion of the project investigated the legal and regulatory basis of offshore cage and oil/gas platform-based aquaculture in the five Gulf states. To view a report resulting from the project, [click here](#). Led by the Mississippi-Alabama Sea Grant Consortium, the Texas Sea Grant College Program, and the Massachusetts Institute of Technology Sea Grant College Program. (FY 1999)

## **Hawaii Offshore Aquaculture Research Project (HOARP) Phase II.**

This project is targeted to continue efforts on demonstration of offshore culture and harvest of Pacific threadfin in a submersible sea-cage located off the coast of Hawaii. This phase of the project resulted in doubling of sea-cage pre-harvest density, evaluating the cage as a fish aggregation device, determining cage impacts on water quality and benthic community structure, and estimating the economics of production. Led by the University of Hawaii and Cates International. (FY 1999)

## **Marine Recirculating Systems Projects**

Marine recirculating aquaculture systems, also known as water reuse systems, reuse water by passing it through a filtration system that removes fish waste and contaminants. Compared to traditional aquaculture practices that use large quantities of high-quality water, recirculating aquaculture systems use less water and land and yet produce similar yields. Recirculating aquaculture currently has a higher production cost than traditional non-recirculating aquaculture.

NMAI-funded projects listed under this topic work to develop new and innovative technologies needed to make marine recirculating operations more competitive. Projects are listed chronologically, starting with those projects that received funding in fiscal years (FY) 2001-2002.

## **Development of an integrated recirculating aquaculture system for nutrient bioremediation in urban aquaculture.**

The goal of this project is to develop a of a relatively small-scale finfish/seaweed recirculating aquaculture system suitable for urban aquaculture and to develop financial models to allow funding of startup business planning to use the system in urban areas. Led by the University of Connecticut, the State University of New York, the University of New Brunswick, the University of New Hampshire, Great Bay Aquafarms, and the Bridgeport Regional Vocational School. (FY 2001-2002)

### **A national planning effort to further national marine recirculating aquaculture.**

This project aims to design a plan to develop recirculating aquaculture science and technology for the commercial production of food. Led by Virginia Polytechnic Institute and State University. (FY 2000)

### **Use of emerging marine recirculating technologies to establish commercial production of high-value marine species.**

This project is working to establish commercial production of the marine finfish pompano through the use of modern marine recirculating technologies. While the development of pompano as a candidate fish for production aquaculture is still in its earliest stages, preliminary project results are encouraging. Led by Louisiana State University's Aquaculture Research Station and the Louisiana Universities Marine Consortium. (FY 1999)

## **Hatchery and Nursery Development Projects**

Without fish to raise, an aquaculture program will have little success. There are typically three stages involved in fish farming: the hatchery (where fish eggs are collected, fertilized, and hatched), the nursery (where recently hatched fish are allowed to grow to juvenile size), and the actual farm (where juveniles grow to market size). In order for an aquaculture program to be successful, it must have access to juvenile fish that can be grown to market size.

Projects listed under this topic address hatchery and nursery development, including things such as breeding programs, cost-effective food for juveniles, and transport of juveniles to cages where they can be grown to market size. Projects are listed chronologically, starting with those projects that received funding in fiscal years (FY) 2001-2002.

### **Using sable fish to create a technical base for marine fish aquaculture in the Pacific Northwest.**

The long-term objective of this project is to develop a viable aquaculture system for the production of sablefish with the Makah Tribe. Researchers will test pilot-scale systems for juvenile production, develop cost-effective and sustainable feed ingredients, and develop environmentally sound methods for growing fish to market size. Led by the NOAA Northwest Fisheries Science Center, the University of Washington, Makah Tribal Fisheries, Spar Technologies, Supreme Alaskan Seafoods, and the Aquaseed Corporation. (FY 2001-2002)

### **Development of reliable spawning, nursery and juvenile production techniques for commercialization of black sea bass aquaculture.**

Identification of new aquaculture species is critical for the U.S. industry to continue to expand. Recent work with black sea bass suggests that this species has characteristics which make it an excellent candidate for commercial development. The goal of this project is to establish a commercial aquaculture industry for black sea bass by improving the predictability of spawning and developing protocols for the commercial-scale production of juveniles. Led by South Carolina Marine Resources Research, the University of New Hampshire, Clemson University, the University of North Carolina, Texas A&M University, NOAA Ocean Service,



the Waddell Mariculture Center, South Carolina Sea Grant Extension, Southland Fisheries, Swimming Rock Fish and Shrimp Company, and Great Bay Aquafarms, Inc. (FY 2001-2002)

**Hatchery production of mutton snapper (*Lutjanus analis*) and other high value marine food fish.**

The main objective of this project is to refine and implement reliable techniques of controlled reproduction and growth of larval mutton snapper, greater amberjack, and other marine fish. Reaching this objective will make large-scale production of fingerlings possible. Project accomplishments have included the successful development of hatchery technology, breeding programs, and larval rearing techniques for cobia and mutton snapper. Led by researchers from the University of Miami, Florida International University, North Carolina State University, Southland Fisheries Corporation, the University of Miami, and Florida Keys Community College, as well as several private consultants. (FY 2001-2002)

**Development of methods for the production of effective micro-particulate feeds for marine fish larvae.**

The overall objective of this project is to develop food capable of supporting the growth and development of marine fish larvae. Formulated diets for marine fish larvae can reduce dependency on live food and improve success in larval growth. Led by Oregon State University, the NOAA Northwest Fisheries Center, and the U.S. Fish and Wildlife Service. (FY 2001-2002)

**Development of large-scale rearing methods for the continuous culture of marine copepods.**

Copepods are the live feed that results in the highest growth and development of fish larvae. Fish fed copepods have been consistently shown to grow faster and develop sooner than fish fed a diet of other small organisms. The overall aim of this project is to develop a culture system for the large-scale production of copepods at the minimum level for economic feasibility. Led by North Carolina State University, Great Bay Aquafarms, and the U.S. Department of Agriculture-Agriculture Research Service. (FY 2001-2002)

**Captive spawning, larval and early juvenile culture of cobia.**

The goal of this project was to develop a process for successful captive culture of cobia. The project has resulted in the successful spawning of healthy cobia eggs in captivity, followed by fertilization and growth of larval and juvenile stages. Protocols were developed for the acquisition, handling, and transport of wild-harvested fish to a finfish aquaculture facility. Raised cobia received high marks in taste tests. Led by the Virginia Institute of Marine Science. (FY 1999)

**Commercial hatchery production of mutton snapper (*Lutjanus analis*) and greater amberjack (*Seriola dumerili*) for growout in offshore cage systems.**

This project focused on developing hatchery technology for the development of commercial tropical marine fish offshore aquaculture in the U.S., especially in the Gulf of Mexico and the Caribbean regions. As a result of the project, offshore aquaculture operations to farm mutton snapper, greater amberjack, and cobia are underway or in development. Led by the University of Miami. (FY 1999)

## Nutrition and Health Projects

The health, nutrition, and food quality of organisms being raised in marine aquaculture programs can impact the success of the program. Food content can also impact the surrounding environment. NMAI-funded projects that fall under this topic are exploring nutrition and health management and technologies, including things such as the development of high-protein foods and vaccines for fish to control the spread of disease. Projects are listed chronologically, starting with those projects that received funding in fiscal years (FY) 2001-2002.

### **Using sable fish to create a technical base for marine fish aquaculture in the Pacific Northwest.**

The long-term objective of this project is to develop a viable aquaculture system for the production of sablefish with the Makah Tribe. Researchers will test pilot-scale systems for juvenile production, develop cost-effective and sustainable feed ingredients, and develop environmentally sound methods for growing fish to market size. Led by the NOAA Northwest Fisheries Science Center, the University of Washington, Makah Tribal Fisheries, Spar Technologies, Supreme Alaskan Seafoods, and the Aquaseed Corporation. (FY 2001-2002)

### **Development of methods for the production of effective micro-particulate feeds for marine fish larvae.**

The overall objective of this project is to develop food capable of supporting the growth and development of marine fish larvae. Formulated diets for marine fish larvae can reduce dependency on live food and improve success in larval growth. Led by Oregon State University, the NOAA Northwest Fisheries Center, and the U.S. Fish and Wildlife Service. (FY 2001-2002)

### **Signature-tagged mutagenesis: A novel and rapid approach for development of aquaculture vaccines.**

Systemic infection by the bacterium *Streptococcus iniae* causes serious fish health and economic problems, which threaten the aquaculture of several commercially important species. This project aims to increase understanding of *S. iniae* virulence using a molecular genetic approach. Project results can aid in the development of vaccines for this disease. Led by Kent Sea Tech and the University of California. (FY 2001-2002)

### **Determination of dietary requirements for cultured summer flounder (*Paralichthys dentatus*) for enhancement of aquaculture potential.**

This project addresses nutritional problems with currently available commercial diets for juvenile summer flounder by investigating basic nutritional requirements for this species. Research will focus on determining the optimal dietary levels that will support maximum weight gain, optimal health, and desirable final body compositional traits in this species. Led by Virginia Tech, the Virginia Seafood Agricultural Research and Extension Center, and Virginia Tech's Veterinary School. (FY 2001-2002)

### **Improved recovery and utilization of seafood processing waste and by-catch in aquafeeds to enhance sustainability of aquaculture.**

This project looks at ways to use fish processing waste and by-catch as aquaculture food. Specifically, the project will attempt to determine the

minimum amount of fish meals from fish processing waste and by-catch needed to provide the essential nutrients required to ensure rapid, economical fish growth in rainbow trout and red drum. The project will also consider the economic impacts of using fisheries by-products in aqua-feeds. Led by Texas A&M University, the Hagerman Fish Culture Experiment Station at the University of Idaho, the NOAA Fisheries Service Alaska Office, and the Texas Sea Grant Extension. (FY 2001-2002)

**Application of Hazard Analysis and Critical Control Point (HACCP) principles as a risk management approach for exotic pathogen control in aquaculture.**

This project applied Hazard Analysis Critical Control Point (HAACP) principles as a risk management approach to control the risk of viral disease transfer to and/or from shrimp aquaculture production and processing facilities. This approach can reduce the potential for negative impacts to wild resources and aquaculture stocks. As a result of the project, a risk management plan and appropriate models were developed. Led by the Virginia Seafood Agricultural Research and Extension Center. (FY 1999)

**Development of a domesticated, Specific-Pathogen-Free (SPF) breeding line of *Penaeus chinensis* for aquaculture use in the U.S.**

This project seeks to breed, develop, and rear a domesticated, specific-pathogen-free line of shrimp for aquaculture in the U.S. Led by the University of Arizona and the University of Texas, in cooperation with the Yellow Sea Marine Fisheries Research Institute in Qingdao, China. (FY 1999)

**Genetic engineering of shrimp cell lines with pantropic retroviral vector.**

This project is improving the competitiveness of shrimp aquaculture in the U. S. by developing a technology that can lead to solutions for infectious diseases that plague the industry. Led by the University of California Department of Pediatrics and the shrimp industry. (FY 1999)

**Best Management Practices Projects**

Operating procedures, schedules of activities, maintenance procedures, and other management practices are needed in order to minimize the environmental impacts of marine aquaculture operations while maximizing economic outputs from these operations. Projects listed here are working towards building effective management practices that can be put to use.

Projects are listed chronologically, starting with those projects that received funding in fiscal years (FY) 2001-2002.

**Production of a best management practices manual for aquaculture in Wisconsin and the Great Lakes region.**

Best Management Practices (BMP) have provided practical and cost-effective methods for environmentally sound and sustainable aquaculture activities. BMPs exist for several locations and industries, but not for aquaculture in the Great Lakes area. The overall goal of this project is to provide information that is needed by current and prospective aquaculturists and regulatory agencies in Great Lakes states, to develop a sustainable aquaculture industry. Led by the University of Wisconsin, the Wisconsin Aquaculture Association, the Wisconsin Department of Natural Resources, the Wisconsin Department of Agriculture, and the Milwaukee Public Museum. (FY 2001-2002)

### **Quantifying impacts of clam culture on adjacent communities.**

This work examines the impact of clam culture in an aquaculture lease area on adjacent communities, which include shallow water soft bottoms, salt marsh, oyster bars, and sea grass beds. Researchers will collect baseline data prior to the initiation of clam culture and will quantify any impacts once leases are stocked. Project results will be used for improved management of aquaculture leases and, if necessary, to refine Florida's Aquaculture Best Management Practices. Led by the Florida Department of Agriculture and Consumer Services. (FY 2001-2002)

### **Application of Hazard Analysis and Critical Control Point (HACCP) principles as a risk management approach for exotic pathogen control in aquaculture.**

This project applied Hazard Analysis Critical Control Point (HAACP) principles as a risk management approach to control the risk of viral disease transfer to and/or from shrimp aquaculture production and processing facilities. This approach can reduce the potential for negative impacts to wild resources and aquaculture stocks. As a result of the project, a risk management plan and appropriate models were developed. Led by the Virginia Seafood Agricultural Research and Extension Center. (FY 1999)

### **Environmental Monitoring and Protection Projects**

As the U.S. marine aquaculture industry continues to develop, management practices and technologies are needed that minimize environmental impacts to the water column, seafloor, and nearby aquatic life.

Included on this page are projects that seek to assess the environmental impacts of aquaculture and to develop new technologies to monitor and mitigate environmental changes associated with aquaculture. Projects are listed chronologically, starting with those projects that received funding in fiscal year (FY) 2004.

### **Environmental and technical assessment of alternative shellfish production methods.**

Researchers are studying the environmental and technical aspects of cage and bag-on-bottom, bag-on-rack, and bottom-suspended oyster and clam culture in the Pacific Northwest. Led by local shellfish growers, the Pacific Shellfish Institute, the Pacific Coast Shellfish Growers Association, the Connecticut Sea Grant Extension Program, the Massachusetts Institute of Technology, and the Virginia Institute of Marine Science. (FY 2004)

### **Beneficial floating reef effects of marine finfish mariculture.**

This project aims to identify and measure colonizing plants and animals that grow on nets, lines, and floats at marine finfish farms in the Pacific Northwest. Data from the project will help in understanding the impacts and/or benefits of floating aquaculture systems to bottom-dwelling plant and animal populations. Led by Rensel Associates Aquatic Science Consultants and Forster Consulting, Inc. (FY 2004)

### **Measurement of the benthic loading and the benthic impact from an open-ocean fish farm in tropical waters.**

This project involves measuring the environmental impact of an open ocean fish farm on sediments and bottom water in the tropical waters of Puerto Rico and Florida. A goal of the project is also to demonstrate that, in the tropics, the abundance of microalgae can be used to signal excess nutrients in the water column (a condition known as "eutrophication"). Led by the University of Puerto Rico, the University of Miami, and NOAA Fisheries Service. (FY 2004)

#### **Using sable fish to create a technical base for marine fish aquaculture in the Pacific Northwest.**

The long-term objective of this project is to develop a viable aquaculture system for the production of sablefish with the Makah Tribe. Researchers will test pilot-scale systems for juvenile production, develop cost-effective and sustainable feed ingredients, and develop environmentally sound methods for growing fish to market size. Led by the NOAA Northwest Fisheries Science Center, the University of Washington, Makah Tribal Fisheries, Spar Technologies, Supreme Alaskan Seafoods, and the Aquaseed Corporation. (FY 2001-2002)

#### **Hawaii offshore aquaculture research Project (HOARP) Phase III: Critical research and development issues for commercialization.**

In this phase of the project to develop offshore aquaculture in Hawaii, researchers are focusing on assessing the short and long-term environmental effects of a tropical open ocean culture farm with multiple cages. Led by the University of Hawaii, Oceanic Institute, and Cates International. (FY 2001-2002)

#### **Ecological characteristics and carrying capacity of suspended shellfish culture systems.**

The goal of this study is to determine the impact of shellfish cultured in an intensive raft culture system on the surrounding environment. Researchers will examine the relationships between oceanographic and physiological processes and nutrient loading and ecosystem function associated with the culture system. Led by the Pacific Shellfish Institute, Taylor Resources, Inc., the Aquatic Environmental Science Lab, the University of Washington, and Northwest Research Associates. (FY 2001-2002)

#### **Quantifying impacts of clam culture on adjacent communities.**

This work examines the impact of clam culture in an aquaculture lease area on adjacent communities, which include shallow water soft bottoms, salt marsh, oyster bars, and sea grass beds. Researchers will collect baseline data prior to the initiation of clam culture and will quantify any impacts once leases are stocked. Project results will be used for improved management of aquaculture leases and, if necessary, to refine Florida's Aquaculture Best Management Practices. Led by the Florida Department of Agriculture and Consumer Services. (FY 2001-2002)

#### **Engineered ecosystems for high rate sustainable marine shrimp and bivalve production.**

The overall goal of this project is to adapt and demonstrate a prototype marine aquaculture system to farm high-value marine shrimp and marine bivalves, with reduced resource inputs and reduced or eliminated environmental impact. Led by Clemson University and Atlantic Aquafarms. (FY 2001-2002)

## **Environmental impact of sustainable offshore cage culture production in Puerto Rican waters.**

The overall goal of this project is to determine the environmental, economical, and social impact of finfish offshore cage culture on tropical marine waters located near Puerto Rico. The environmental component will evaluate the impact of cage culture on the chemical, physical, and biological variables in the area surrounding the commercial-scale operation. The project will evaluate negative and positive perceptions and attitudes, support from the community, potential vandalism, and poaching. Possible conflicts with the fisheries industry, tourism, and boat traffic will also be analyzed. Led by the Puerto Rican Commercial Aquaculture Research and Development Center and the University of Miami. (FY 2001-2002)

## **Development of model codes of practice for environmentally responsible aquaculture using the multi-species Maine industry as a foundation.**

Using the Maine aquaculture industry as a model, this project will develop model codes of practice, as well as model worksheets, for adaptation by aquaculturists seeking to develop environmentally responsible aquaculture programs throughout North America. Led by a local grower, the Maine Department of Marine Resources, and the Maine Aquaculture Innovation Center. (FY 2000)

## **Developing environmental codes of practice for the Pacific coast shellfish industry.**

This project seeks to establish an environmental code of practice for shellfish growers along the Pacific coast. This code of practice will implement the environmental policy statement already drafted by the Pacific coast shellfish aquaculture industry as a component of the effort to develop an environmental management system for shellfish aquaculture on the Pacific coast. Led by the Pacific Coast Shellfish Growers' Association and a local grower. (FY 2000)

## **Reducing the risk of open-ocean aquaculture facilities to protected species.**

This project, which was to be completed in 2001, sought to develop a transmitting buoy that would be activated by an entangled large marine mammal. A whale would put excessive stresses on a submerged long-line mussel aquaculture mooring, break a weak line, and would trigger a release to allow a submerged telemetry buoy to surface. Once at the surface, the buoy would start transmitting a distress signal to alert personnel that a mammal had been entangled. Led by Woods Hole Oceanographic Institution. (FY 1999)

## **Policy Development Projects**

In the United States, freshwater aquaculture is more common than marine aquaculture. Within the realm of marine aquaculture, policy frameworks are needed to ensure that activities occur in an environmentally responsible way. This is especially true with respect to offshore or open ocean aquaculture, which would occur in the U.S. Exclusive Economic Zone, where there is no clear legislation governing aquaculture activities.

NMAI-funded projects listed on this page seek to evaluate and develop policies to regulate marine aquaculture activities. Projects are listed



chronologically, starting with those projects that received funding in fiscal years (FY) 2001-2002.

### **Development of a national aquatic animal health plan for the Exclusive Economic Zone (EEZ).**

This project will develop a National Aquatic Animal Health Plan for Salmonids (NAAHPS), which will contain components to provide for the safe and efficient intrastate, interstate, and international transport of aquatic animals produced in the Exclusive Economic Zone (EEZ). Lessons learned during the project will result in a more rigorous NAAHPS and allow the plan to be a model for developing other aquacultured species group plans. This project will also outline a framework to organize other species group plans into a coordinated, overall National Aquatic Animal Health Plan. Led by NOAA Fisheries Service and the Washington Department of Fish and Wildlife. (FY 2001-2002)

### **Clarifying marine aquaculture legal rights: Improving the legal interest framework.**

By assessing the attitudes of state, local, and federal governments and the public to marine aquaculture development, this project seeks to evaluate legal barriers to marine aquaculture development that are connected to social and cultural concerns of coastal and traditional fishing community members, as well as the physical, chemical, and biological capacity of prospective development sites. Led by the University of Maine Law School. (FY 2001-2002)

### **Development and testing of an operational framework for offshore aquaculture in conjunction with stakeholders at national and regional levels.**

Building on the work from a previously funded project by Sea Grant, this project team will work with stakeholders at national and regional levels to develop and test an operational framework for offshore aquaculture. The team will focus on procedures for planning and site assessment for aquaculture operations in the 200-mile ocean zone, joint state/federal permitting process for aquaculture, guidelines and standards for the environmental review process, guidelines and standards for issuance leases, and monitoring guidelines. Led by the University of Delaware, NOAA Fisheries Service, the State of Hawaii, South Carolina Sea Grant, the Delaware Aquaculture Resource Center, the Sea Grant Law Center, the Policy Center for Marine Bioscience and Technology at the University of Massachusetts, the Coastal States Organization, Texas Sea Grant, Moonstone Oysters, Sea Web, and several private consultants. (FY 2001-2002)

### **Improving the regulatory framework for marine aquaculture regional planning and economic decision-making.**

By developing economic models, compiling data, and conducting analyses, this project will contribute to the development of a procedure that will lead to more efficient and transparent licensing and permitting for marine aquaculture in the northeast U.S. To view a preliminary tool for siting aquaculture, developed through this project, [click here](#). Led by Woods Hole Oceanographic Institution. (FY 2000)

### **Identification and mitigation of legal and regulatory hurdles to offshore aquaculture in the Gulf of Mexico.**

This project seeks to identify and mitigate the legal and regulatory hurdles to offshore aquaculture in the Gulf of Mexico. The project is the beginning of a multi-phased effort to develop an efficient and transparent permitting process and to produce a user-friendly guide to aquaculture siting and permitting in the U.S. Exclusive Economic Zone (EEZ). Led by Texas, Louisiana, and Mississippi-Alabama Sea Grant Programs. (FY 2000)

#### **A code of conduct for net-pen salmon farming.**

This project will establish a Code of Conduct for net-pen farming in the Pacific northwest. Experts from NOAA's National Marine Fisheries Service and regional stakeholders will evaluate the risks and benefits of net-pen farming in the region and, with the Washington Fish Growers' Association, will use this scientific, technical, and regulatory information to produce the code. To view the resulting code of conduct, [click here](#). Led by the Washington Fishgrowers' Association and NOAA National Marine Fisheries Service. (FY 2000)

#### **Strengthening aquaculture planning and coordination in the Pacific region.**

This project will strengthen the newly-formed Pacific Aquaculture Caucus (PAC) by holding three sub-regional events in Alaska, Idaho/Washington, and Oregon/California. The goals of these meetings are to increase membership among the grass-roots of the industry, expand its constituency and geographic influence, and through the strengthened organization, become an advocate for the industry. Led by the Pacific Aquaculture Caucus. (FY 2000)

#### **Development of a framework for addressing state/federal aquaculture activities.**

Through a workshop, this project developed a framework for use by Atlantic coast state, federal, and inter-jurisdictional fisheries management agencies in addressing aquaculture issues. The intent of the framework is to provide guidance in addressing developmental and environmental issues relating to aquaculture activities in state waters. Led by the Atlantic States Marine Fisheries Commission. (FY 2000)

#### **A policy framework for offshore marine aquaculture in the 3-200 mile U.S. ocean zone.**

This project produced the first comprehensive assessment of federal policy with respect to the development of aquaculture as a new ocean industry in federally controlled waters off the U.S. coast. The proposed policy framework addresses the full life-cycle of offshore aquaculture projects and advocates the development of an overall policy for planning and governing all activities in the U.S. Exclusive Economic Zone, including aquaculture. Led by the University of Delaware. (FY 1999)

#### **Biological engineering, environmental and legal research for the development of offshore cage aquaculture in the Gulf of Mexico.**

This project is monitoring fish behavior using the cage system as a fish aggregating device, while also evaluating the ecological impact of the system on wild fish. The legal research portion of the project investigated the legal and regulatory basis of offshore cage and oil/gas platform-based aquaculture in the five Gulf states. To view a report resulting from the

project, [click here](#). Led by the Mississippi-Alabama Sea Grant Consortium, the Texas Sea Grant College Program, and the Massachusetts Institute of Technology Sea Grant College Program. (FY 1999)

## **Outreach Activities and Programs**

Involvement from representatives from academic institutions, government agencies, non-governmental organizations, private industry, and the general public is key to developing aquaculture programs that are economically, socially, and environmentally sound.

NMAI-funded projects listed under this topic aim to engage and educate constituents and community members about marine aquaculture. Projects are listed chronologically, starting with those projects that received funding in fiscal years (FY) 2001-2002.

### **Massachusetts Ocean Resource Information System (MORIS).**

The Massachusetts Ocean Resource Information System (MORIS) addresses several obstacles to the development of marine aquaculture, including concerns over environmental impacts, difficult permit and licensing processes, and multi-use conflicts in the coastal zone. This project will provide easy-to-use applications and a centralized database of resources. This phase of the project consists of outreach, training, data mining and data development to improve the geographic information systems (GIS) based tool developed in the previous phase of the project. Led by the Massachusetts Office of Coastal Zone Management, the Massachusetts Department of Food and Agriculture, Woods Hole Sea Grant, and the Massachusetts Division of Fisheries. (FY 2001-2002)

### **Development and testing of an operational framework for offshore aquaculture in conjunction with stakeholders at national and regional levels.**

Building on the work from a previously funded project by Sea Grant, this project team will work with stakeholders at national and regional levels to develop and test an operational framework for offshore aquaculture. The team will focus on procedures for planning and site assessment for aquaculture operations in the 200-mile ocean zone, joint state/federal permitting process for aquaculture, guidelines and standards for the environmental review process, guidelines and standards for issuance leases, and monitoring guidelines. Led by the University of Delaware, NOAA Fisheries Service, the State of Hawaii, South Carolina Sea Grant, the Delaware Aquaculture Resource Center, the Sea Grant Law Center, the Policy Center for Marine Bioscience and Technology at the University of Massachusetts, the Coastal States Organization, Texas Sea Grant, Moonstone Oysters, Sea Web, and several private consultants. (FY 2001-2002)

### **Marine aquaculture and the environment: A meeting for stakeholders in the Northeast.**

Through a workshop, this project brought together members of the aquaculture industry, environmental groups, government, and academia to understand the barriers to the development of sustainable marine aquaculture and to facilitate a collaborative approach to address these challenges. Workshop participants reached consensus on a number of points, including the need for zoning and comprehensive planning and the fact that aquaculture can have negative and positive environmental effects.

The conference proceedings are now being edited and will be published as a book. Led by the University of Massachusetts. (FY 2000)

### **Electric information and education for the aquaculture industry through a Web-based network of aquaculture information services.**

This project resulted in the development and implementation of a virtual clearinghouse for information on aquaculture. This system provides 24-hour access to a variety of databases, and links expertise within Maryland Sea Grant and the NOAA Central Library with ongoing efforts within the Illinois-Indiana and Delaware Sea Grant Programs. Led by the Illinois-Indiana Sea Grant College Program, the Sea Grant Marine Advisory Service at the University of Delaware, and the Maryland Sea Grant College Program. (FY 1999)

### **Geographic Information System Tools**

Tools such as geographic information system (GIS) databases can be used to find suitable locations for aquaculture operations and ensure that these operations are not negatively impacting the environment. Using such tools can increase the likelihood that an aquaculture program will maximize economic output without negatively disrupting the environment.

Projects described on this page involve the development and implementation of GIS and other tools to analyze data and help in making reliable aquaculture decisions. Projects are listed chronologically, starting with those projects that received funding in fiscal years (FY) 2001-2002.

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### **Offshore finfish mariculture in the Western Strait of Juan de Fuca, Washington State.**

This project focuses on the development of environmental data to support permit applications by interested investors for offshore net-pen finfish aquaculture in northwest Washington. It will use environmental modeling and a geographic information systems (GIS) program for data analyses and presentation. Project reports and work products will help the Washington Fish Growers Association, the Washington State Department of Natural Resources, and the Makah Tribe to develop finfish aquaculture in the Juan de Fuca Straits.

Led by the Washington Sea Grant Program, Rensel Associates, Battelle Marine Science Lab, the University of Southern California, Bellweather Consulting, the Washington Fish Growers Association, the Washington Department of Natural Resources, the Washington Department of Ecology, the Washington Department of Fish and Wildlife, the Makah Tribal Nation,

and several private consultants. (FY 2001-2002)

**Using GIS for offshore aquaculture siting in the U.S. Caribbean and Florida.**

This project will design and construct a geographic information system (GIS)-based decision support tool to allow optimal location of caged aquaculture projects planned for offshore Florida, Puerto Rico and the U.S. Virgin Islands. Led by the University of Miami, NOAA Fisheries Service, the Florida Department of Agriculture—DNER/Marine Resources Division, and Puerto Rico's Coastal Zone Program. (FY 2001-2002)

**Evaluating open ocean aquaculture sites using GIS and regulatory processes in Hawaii.**

This project will identify offshore sites among the main islands of Hawaii that will be suitable for marine aquaculture and subsequent development of open ocean aquaculture parks by incorporating existing federal, university, and state oceanographic data sets into a geographic information system. Led by the University of Hawaii. (FY 2000)

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